34

CLAIMS:

1. A method of measuring an apparent depth of a section of an eye, the section being defined by first and second interfaces, comprising the steps of:

a) focusing light to a measurement location proximate or within the eye;

b) scanning the measurement location through the section;

c) detecting reflected light from the measurement location as the measurement location passes through the first and the second interfaces and generating a signal representative of the detected light; and

d) deriving from the signal apparent positions of the first and the second interfaces.

2. The method of claim 1, wherein the section is the aqueous humor of the eye and the apparent depth is an optical path length through the aqueous humor.

3. The method of claim 2, wherein the first interface is a surface between the cornea and the aqueous humor of the eye and the second interface is a surface between the aqueous humor and the ocular lens of the eye.

4. The method of either of claim 2 or claim 3, further comprising the step of comparing the derived apparent depth with a previous reference measurement of the apparent depth, so as to determine a change in the refractive index of the aqueous humor.

5. The method of claim 4, further comprising the step of calculating a measure of change in a concentration of glucose within the bloodstream of a patient from the change of refractive index.

6. The method of any preceding claim, wherein the detected light is arranged to comprise substantially only light which has been focused to the measurement location and reflected by an interface of the eye.

35

7. The method of any preceding claim, wherein scanning step (b) is achieved by one of translating a lens; translating a lens and varying a numerical aperture (NA) of the lens; translating a mirror of a mirror assembly; varying a refractive index of a variable refractive index element; or varying a focal length of a variable focal length lens.

8. The method of any preceding claim, wherein the signal peaks for points where the measurement location is coincident with an interface of the eye.

9. The method of any preceding claim, wherein the light has a single wavelength.

10. The method of any one of claims 1 to 8, wherein the light comprises two or more wavelengths.

11. The method of any preceding claim, further comprising the prior step of providing a reference image, or object, to be focused by the eye during scanning, so as to enable the eye to be repeatably aligned.

12. The method of any preceding claim, wherein one or more interfaces of the eye is curved and has a centre of curvature, further comprising the step of detecting reflected light from the curved interface when the measurement location is coincident with the centre of curvature of the curved interface, such that a distance between the curved interface and its centre of curvature may be derived.

13. An apparatus for measuring an apparent depth of a section of an eye, the section being defined by first and second interfaces, comprising:

a) an optical focusing assembly, adapted to focus incident light to a measurement location proximate or within the eye;

b) a scanning assembly, adapted to scan the measurement location through the section;

36

c) a detector, adapted to detect reflected light from the measurement location as the measurement location passes through the first and the second interfaces and adapted to generate a signal representative of the detected light; and

d) a processor, adapted to derive from the signal apparent positions of the first and the second interfaces.

14. The apparatus of claim 13, the scanning assembly comprising a scanning stage, adapted to translate an element of the optical focussing assembly such that the measurement location is correspondingly scanned, wherein the processor is further adapted to track the translation of the element and thereby derive a position of the measurement location.

15. The apparatus of either of claim 13 or claim 14, wherein the processor is further adapted to compare the derived apparent depth with a previous reference measurement of the apparent depth, such that a change in the refractive index of the section may be determined.

16. The apparatus of any one of claims 13 to 15, wherein the detector is further arranged to detect substantially only light which has been focused to the measurement location and reflected by an interface of the eye.

17. The apparatus of any one of claims 13 to 16, wherein the light has a single wavelength.

18. The apparatus of any one of claims 13 to 16, wherein the light comprises two or more wavelengths.

19. The apparatus of any one of claims 13 to 18, further comprising means to display a reference image, or object, for focusing by the eye during scanning, such that the eye may be repeatably aligned.

20. A method of measuring a property of an eye, comprising the steps of:

37

a) directing light from a light source to a first reference location;

b) spatially filtering light not received at the first reference location;

c) receiving light from the first reference location and focusing the light to a measurement location;

d) scanning the measurement location along a measurement line within the eye;

e) receiving reflected light from the measurement location and focusing the reflected light to a second reference location;

f) spatially filtering reflected light not received at the second reference location;

g) measuring an intensity of the reflected light received at the second reference location;

h) relating an intensity measurement to an apparent position of the measurement location;

i) selecting intensity measurements of interest, the intensity measurements of interest representing measurement locations of interest; and

j) determining a distance between the measurement locations of interest.

21. The method of claim 20, wherein the measurement line passes through the cornea, the aqueous humor and the lens of the eye.

22. The method of either of claim 20 or claim 21, wherein an intensity measurement of interest includes a reflected light intensity peak, representing a boundary between either the cornea and the aqueous humor, or the aqueous humor and the lens.

23. The method of any one of claims 20 to 22, wherein the distance between measurement locations of interest is an optical path length through the aqueous humor of the eye.

24. The method of any one of claims 20 to 23, wherein the first and second reference locations are coincident.

38

25. The method of any one of claims 20 to 24, wherein scanning step (d) is achieved by one of translating a lens; translating a lens and varying a numerical aperture (NA) of the lens; translating a mirror of a mirror assembly; varying a refractive index of a variable refractive index element; or varying a focal length of a variable focal length lens.

26. The method of any one of claims 20 to 25, further comprising controlling the light such that the light has one of a static, jittered, swept or stepped wavelength.

27. The method of any one of claims 20 to 26, further comprising the steps of modulating the light and detecting the phase of the light received at the second reference location.

28. The method of any one of claims 20 to 27, further comprising the step of generating light having two or more wavelengths, such that two or more properties of the eye may be measured.

29. The method of any one of claims 20 to 28, further comprising the step of producing light having two or more polarization states, such that two or more properties of the eye may be measured.

30. The method of any one of claims 20 to 29, further comprising the steps of:

i) producing a beam of coherent light;

ii) splitting the light beam into a probe beam and a reference beam, such that the probe beam is controlled according to the method of any one of claims 20 to 29;

iii) interfering the probe beam and the reference beam at a detector; and

v) measuring a resulting interference pattern.

31. The method of any one of claims 20 to 30, further comprising the step of effecting a reference accommodation of the eye by placing a reference object in a line of sight of the eye.

39

32. The method of any one of claims 20 to 31, wherein one property of the eye is a refractive index of the aqueous humor.

33. The method of any one of claims 20 to 31, wherein one property of the eye is a thickness of either the cornea or the lens.

34. An apparatus for measuring a property of an eye, comprising:

a light source;

a source optical element, adapted to direct light from the light source to a first reference location;

an objective optical element, adapted to receive light from the first reference location and to focus the light to a measurement location, the objective optical element being further adapted to scan the measurement location along a measurement line within the eye;

a return optical element, adapted to receive reflected light from the measurement location and to focus the reflected light to a second reference location;

an optical detector, adapted to measure an intensity of the reflected light received at the second reference location; and

a processor, adapted to relate an intensity measurement to an apparent position of the measurement location, such that an apparent distance between measurement locations of interest, represented by respective intensity measurements of interest, may be derived.

35. The apparatus of claim 34, wherein the measurement line passes through the cornea, the aqueous humor and the lens of the eye.

36. The apparatus of either of claim 34 or claim 35, wherein an intensity measurement of interest includes a reflected light intensity peak, representing a boundary between either the cornea and the aqueous humor, or the aqueous humor and the lens.

40

37. The apparatus of any one of claims 34 to 36, wherein the distance between measurement locations of interest is an optical path length through the aqueous humor of the eye.

38. The apparatus of any one of claims 34 to 37, wherein the source optical element comprises one of a lens configuration, an optical fibre, or another light guide structure.

39. The apparatus of any one of claims 34 to 38, wherein the first reference location is provided by one of a pinhole aperture, a source-detector combination, an optical fibre, or another light guide structure.

40. The apparatus of any one of claims 34 to 39, wherein the objective optical element and/or the return optical element comprises a compound lens.

41. The apparatus of any one of claims 34 to 40, wherein the objective optical element and the return optical element are constituted by the same optical element.

42. The apparatus of claim 41, wherein the first and second reference locations are coincident.

43. The apparatus of claim 40, and either of claim 41 or claim 42 when dependent upon claim 40, further comprising a translation stage, adapted to translate a lens of the compound lens and thereby to scan the measurement location along the measurement line.

44. The apparatus of any one of claims 34 to 43, wherein the light source comprises a white light source and one of a spectrometer, an etalon, or a multiplexer.

45. The apparatus of any one of claims 34 to 44, further comprising a reference object for viewing by the eye, the reference object being positioned such that an accommodation of the eye may be repeatably achieved.

41

46. A micro-electromechanical system, comprising the apparatus of any one of claims 13 to 19 or 34 to 45.

47. A hand-held device, comprising the apparatus of any one of claims 13 to 19 or 34 to 45 or the micro-electromechanical system of claim 46.

48. An apparatus for measuring a property of an eye substantially as herein described with reference to the accompanying drawings.

49. A method of measuring a property of an eye substantially as herein described with reference to the accompanying drawings.